Understanding Twitter Influence in the Health Domain: A social-psychological contribution

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ABSTRACT
Twitter can be a powerful tool for the dissemination and discussion of public health information but how can we best describe its *influence*? In this paper we draw on social-psychological theories such as social norms, social representations, emotions and rhetorical psychology to explain how influence works both in terms of the spread of information and also its personal impact. Using tweets drawn from a range of health issues, we show that social psychological theory can be used in the qualitative analysis of Twitter data to further our understanding of how health behaviours can be affected by social media discourse.

Categories and Subject Descriptors
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Human Factors, Theory.

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Social media, influence, social psychology, methods, theory

1. INTRODUCTION
Since 2006, the popularity of the micro-blogging service Twitter has grown rapidly to cover a user base of over 200 million in March 2013 [6]. The platform is very influential, demonstrated in part by the number of high-profile celebrities and politicians using it to communicate with the public. It is therefore with good reason that public health bodies often use Twitter to communicate with the public during critical incidents such as pandemics [7, 17, 25] as well as chronic health issues such as obesity [13]. This raises a number of questions regarding how best to use Twitter in the communication of health information, including: "What kinds of information should be tweeted for maximal influence?" and "What makes people trust information conveyed in this format?" These are questions we have been asking in a recent project which is exploring how Twitter is used to disseminate messages about the H1N1 pandemic. However, the questions can be applied to a wide range of health problems. We give examples, drawing on a theoretical framework from social psychology to better understand the core issues.

2. What is influence?
As messages are transmitted via Twitter, these tweets influence others in various ways. Some tweets are more influential than others and are retweeted or viewed by many. By "influence" then, we refer to two things: (1) the number of people affected by the message (extensity) and (2) the cognitive, emotional and behavioural impact of the message on the readers (intensity). Both have similarities and links to the idea of "social influence" within social psychology which can be defined as "psychological phenomena that often occur in direct response to overt social forces" [8]. In our case, the social forces are mediated by Twitter and its user base and the psychological phenomena have to be conceptualised in terms of outcomes such as retweets or responses.

The first definition of influence (extensity) is associated with numerous metrics that can provide an indication of the extent to which any particular tweet will be viewed [41]. This can be calculated based on the number of followers that a user has, the number of replies that a tweet receives and the number of times the message is retweeted [41]. Others use different metrics based on user characteristics such as ratio of followers to following and retweet and mention ratio [1]. Either way every user can be assigned an influence value and every tweet can be assigned the same. This can be used to estimate the influence that a particular message will have on Twitter.

The second definition of influence refers to its intensity. So a message might be spread widely because of a user having a large number of followers but it may not have influence in terms of provoking change in cognition, emotions or behaviour. The persuasive power of a message can be referred to as its rhetorical influence which consists of three elements taken from rhetorical theory: logos (the content of the message), ethos (the credibility of the author) and pathos (the emotion of the message) [22, 23]. When these elements are appropriately handled the message is persuasive and can have influence. For example, the elicitation of certain emotions (e.g. guilt) have been associated with compliance with requests [8]. Again, the authority of certain figures has been shown to affect obedience with instructions [8, 31].

At times both the first and second forms of influence can operate together. If certain persuasive messages are shared by multiple people a group norm may emerge regarding how to think, feel or act about a certain issue. Normative messages paired with appropriate emotions (i.e. approval-related emotions) have been shown to have a positive effect on behaviours such as littering [35]. Even the simple spreading of messages which communicate what people are doing can create a descriptive norm which has some effect on those who seek to act in accordance with the behaviour of others [32]. When people are affected by group norms they may do so through various processes including compliance, identification and internalisation [1, 8]. These processes lead Twitter users to react to the messages with varying degrees of intensity but nonetheless often provoke behaviour change of some kind.

This discussion of influence is important because it helps to show how a health message transmitted via twitter can affect behaviour. If the message is spread to enough people (extensity) with the correct *intensity*, social norms may be created which motivate people to enact positive health behaviours such as hand-washing, vaccination or healthy eating.

3. Analysing extensity influence

As mentioned previously, there are various ways of operationalizing extensive influence on Twitter. These include counting retweets, number of followers and use of hashtags. Below we offer an overview of research which looks at these different ways of spreading messages and the different effects of influencing others in these ways.

3.1 Retweets

Retweeting is perhaps one of the most obvious ways of assessing the level of influence of a message. When people read a message that they like or think is important to share, they will often use the retweet function to spread the message to their own followers. While there is some variation in syntax, the use of the retweet button in the Twitter web interface and app leads to general consistency in usage such that "RT @username" is standard. People tend to retweet for a variety of reasons including sharing information with a new audience, starting a conversation about the content of a tweet, making the original tweeter aware that they are being listened to, publicly agreeing with someone, obliging a request to retweet, or to save tweets for future reference [5]. Specific content such as breaking news stories tend to be retweeted a lot. Furthermore, the process of retweeting a message can sometimes require the omission of crucial information. For example, a message which is posted with a question appended may get shared with the question omitted and in this way, rumours become fact. Even further tweets of clarification from the initial author may do little to rectify the misinformation since it may not be retweeted. Potentially, this is relevant for our consideration of health information because when crucial messages are tweeted, they may be reconfigured in such a way as to change the messages that were intended. In this way rumours can spread on various parts of the social network. Because of the impact of rumours, some suggest that organisations should actively counteract rumours via social media [20].

But why does some information get retweeted more than others? Clearly the answer to this will vary depending on what topic is being tweeted about but there are some factors which in general will affect the extent to which a tweeted is retweeted. Features such as the presence of URLs, hashtags, number of followers, followees and age of account all correlate with the number of retweets however number of past tweets does not predict retweets [37]. Others find that negative emotions in tweets facilitate rapid spread and conclude that "bad news travels fast" [30]. While this information has some utility, for the most part it is too simplistic to be of much practical use. Simply demonstrating correlations between structural aspects of a tweet and number of retweets neglects the more important semantic features which drive the sharing of information on Twitter. Research needs to attend to the meaning of tweets and not just structural features if it wants to investigate the drivers of retweets. One of these semantic features is the presence of a simple request ("Please RT") [26] and this effect can be seen in the massive number of retweets received by the anti-smoking campaign "Stoptober" (a word-play on "October") who received 1299 retweets by saying, "RT if you're one of the thousands of people across England who are going Smokefree for #Stoptober". Users then retweeted the message from other users who had retweeted it leading to a massive surge in tweets about Stoptober on 1st October 2012.

One interesting finding in relation to extensive influence is that when a tweet is retweeted, even if the original sender only has a small number of followers, the tweet spreads to an average of 1000 users [24]. Half of retweeting happens within an hour, 75% less than a day and 10% a month later. Information gets retweeted rapidly and almost immediately on the 2nd, 3rd and 4th steps away from the original. Thus a retweet starts a rather rapid cascade of sharing.

3.2 Hashtags

As noted above, the presence of hashtags increase the likelihood that a message will be retweeted [37]. Hashtags are a signal that the message being tweeted belongs to a category of messages which can be viewed by searching for it. Popular hashtags are displayed to users at the side of their screen which may encourage them to view or contribute to a particular category of discussion. Often the hashtags from personal users are about mood or their current activity [40] or about the topic they are posting on (e.g. "#stopsmoking or #flu"). Mood hashtags can be used to perform sentiment analysis which can give insight into temporal emotion trends in relation to a certain topic [39]. However, caution must be exercised in assuming that the presence of hashtags will automatically increase the number of retweets. Some researchers found that hashtags did *not* significantly affect sharing when they analysed tweets during a storm in New York [12]. There are a range of variables that are likely to influence retweeting and the presence of hashtags is likely to interact with some of them so that under specific conditions, the presence of hashtags may or may not have any effect on message-sharing.

3.3 Followers

The influence of a message will also be affected by the number of followers a person has. A message about a pandemic shared by Jim Carry (@jamescarry) who has 21849 followers may be seen by more people than NHS Swine Flu News (@NHSFlu) who only have 3087 followers (as of December 2013). But these differences ought not to be overplayed because while the latter may have less followers, a message shared by them via @nhschoices will reach another 108811 followers. This leads some to conclude that while on blogs and traditional media there are a small number of very influential sites, on Twitter, 'influencers' are less influential and have a smaller overall effect [40]. Similarly, others argue that the number of followers a person has is not a good measure of influence since their messages may not get any further than the initial audience who may dismiss the message or consider it unworthy of sharing [33].

3.4 Temporality

One final point to consider in relation to extensive influence on Twitter is the temporal duration of the content. Information that trends on Twitter tends to last only for a short period of time - around 20-40 minutes [2]. However, depending on the nature of the topic, trends can last for longer periods of time. Such topics are typically issues that have a resonating significance. For example, in the case of a pandemic we would expect a hashtag such as #swineflu to have an enduring presence for the course of the pandemic whereas #narcolepsy would peak when a scare emerges regarding vaccination. Similarly, most retweets take

place within a relatively short space of time: 50% within an hour and 75% within a day [24]. Around 10% of retweets occur one month later which indicates that there is some persistence of messages even if at a low level. Thus Twitter tends to be a rapidly changing environment with new trends emerging frequently even as others fade. This poses challenges for the sustained influence of health campaigns on social media. Perhaps though, the best campaigns are those that aim, not to have a long-term presence on social media, but those that aim to have a short but powerful impact. For example, effective campaigns such as "Stoptober" (no smoking) and "DryJanuary" (no alcohol) were able to generate trends as large numbers of users tweeted about starting the event. While this may not have generated a long-term trend it nevertheless raised the awareness of the event and prompted much discussion.

3.5 Social Psychology and Extensive Influence

When a message is spread extensively throughout social media, various psychological effects can be inferred. Here we mention two of these: social norms and social representations.

Social norms are a component of more than one theory but the idea central to them all is that human behaviour is shaped by shared rules for social behaviour. These norms can be either injunctive or descriptive. The former are moral obligations while the latter are indications of the behaviour of others. So, for example, if many people indicate via Twitter that they are going to engage in behaviours such as vaccination or non-smoking, this can create or consolidate a social norm. At the start of campaigns such as "DryJanuary" or "Stoptober" many users tweet that they are starting the month-long health event and this creates normative expectations among many users about socially desirable behaviours during this period. These norms are likely to be generated within specific groups of users who share a social identity and are linked together in an online network [15]. Potentially then, whole groups of people can be identified who react positively or negatively to health interventions.

Another theoretical perspective on extensive influence is social representation theory [19, 28] which relates to the way representations of an issue build up to provide a societal perspective on an issue. Understanding how social representations are constructed and perpetuated helps to comprehend the "reification and legitimisation" [19] of systems of understanding the world and issues within it. As an example of how influential a social representation can be, consider the attitude of many Turkish citizens who did not want to be vaccinated against H1N1 – because of the societal understanding that the vaccine was useless or harmful [9]. Cirhinlioğlu & Cirhinlioğlu (2010) note that there was a "difference between the reality of health as described by the authorities and the reality perceived and interpreted at the social-individual level" (p. 288) [9]. Understanding how these different representations of the illness function is vital to understanding why different people behave in different ways than the authorities might like them to. In other societies, the social representations of the H1N1 virus were markedly different. In Malaysia, pig farmers often reported that friends had avoided them because of the epidemic as well as suggesting that certain groups such as homosexuals, the homeless and prostitutes were more likely to contract the virus [14]. And while the media are attributed responsibility for generating social representations of pandemics [21], the role of social media must be accorded increasing importance in light of its increased use. Analysing data this way often provides an insight into how different cultures or countries think about health issues.

Extensive influence can operate via a number of means such a retweeting, number of followers and the use of hashtags. The psychological impact of this includes the production of social norms and emergence of social representations of health and illness.

4. Analysing intensity influence

When it comes to analysing the intensive influence of tweets we are starting to think about how tweets can be influential by virtue of their content. This content can be thought about in various ways including emotion, themes, content category and rhetorical strategy. It will be helpful to survey these different means of influence with reference to health pandemics.

4.1 Rhetoric

The term "rhetoric" refers to the way a message is constructed in order to persuade an audience. Tweets, like any other form of discourse, are rhetorical and make use of the three aspects of rhetoric: logos, ethos and pathos [22]. Taking the example of a recent UK public health campaign called "Stoptober", logos, the content of the message, can be seen in messages that emphasise statistics or facts. One user tweeted, "I will save £161.00 during #stoptober" thereby justifying his decision on financial grounds. Ethos is appealed to by invoking the credibility of the speaker. So when one user tweets "Good luck to everyone giving up smoking today #stoptober #best thing I ever did !" he appeals to his own experience as an ex-smoker to encourage others to stop. A user can use pathos by appealing to emotion. An example of this can be seen when one user retweeted another user's comment and appended a message of emotional approval: "@a***: #stoptober today got my stress ball at the ready" YES A***! I'm proud!" Other examples could be furnished but these show how different strategies can be used to persuade people and develop intensive impact. While a message can involve multiple persuasive appeals, often a particular appeal is dominant and observation of a high volume of such an appeal can indicate the most persuasive messages surrounding a health issue at a certain time.

Another aspect of rhetorical strategy is the framing of a message [38]. This idea comes from Bateson (1955) who argued that all messages are framed in terms of an overarching message (metamessage) which directly affects interpretation [4]. Thus a message framed as "parody" is interpreted in a radically different way from a message framed as "news report". While extensive research has looked at how the media frame issues to influence the public to think and talk about them in certain ways, less attention has been paid to framing in social media. However, the impact of social media in recent political revolutions has led some scholars to pay more attention to the framing of issues online. They find that Chinese bloggers lead in framing issues relating to governmental irresponsibility and that during the Egyptian uprising, social media used different framing compared to state or independent news agencies [18]. And this has relevance for the issue of pandemics because different organisations may frame the issues differently and this different framing will lead to different responses from the audience. Liu & Kim (2011) categorised messages on social and traditional media during the H1N1 pandemic according to a topology consisting of four distinct frames: general crisis, disaster, health crisis and general health issues. They suggest that framing has four functions: (1) identify causation, (2) identify source of the problem, (3) make moral

judgements about the situation, (4) provide solutions [25]. Each of the four frames has different perspectives on these functions. They find that social media and traditional media both use the general crisis frame as often as each other while traditional media tended to use disaster, health crisis and general health issues frames more often. Having shown that the general crisis frame is used frequently by both types of media, they suggest that publics would have been better prepared had they used the health issue frame which emphasises prevention behaviours and lifestyle risk factors to encourage positive health behaviours. Furthermore, they suggest that the general health frame may have increased vaccination uptake and increased long-term positive health behaviours. Clearly this is an empirical question and one which they cannot answer with their data but it gives an insight into the fact that the framing of an issue is influential in determining how people respond to it, both cognitively and behaviourally. Returning to the issue of "Stoptober", different frames can be seen in Twitter messages. One is a motivational frame in which the campaign is seen as something which involves peer support and encouragement: "#Stoptober day one - good luck to all of you smokers!" Another is a sceptical frame which mocks or makes fun of the campaign: "Lol no chance #stoptober". Yet another frames it as a challenge to be accepted: "First day of non smoking, stoptober bring it on". This is just a brief sketch but it shows that the framing of health messages will affect how and in what direction they influence others.

Related to the issue of framing is that of how a message is changed as it is passed on – a phenomenon known as reconstruction or recontextualisation [3, 27]. When a message is passed on it always carries a different meaning, even when the content itself is not changed. Yet the context for receipt of the message varies: the audience changes, the time tweeted changes and the person tweeting changes and these factors at least make the message take on a subtly different meaning. Sometimes the changes in meaning are less subtle and require the content of the message to be changed in some way [29]. An example of how reconstruction occurs can be seen in the tweets about a recent BBC News article entitled, "Vitamins 'effective in treating ADHD symptoms'". While most tweets simply repeated the title along with the link, others added hashtags such as #ADHD or #Vitamins depending on their emphasis. Another person tweets the link saying, "Effects r far more moderate than medication but still interesting.BBC: Vitamins 'effective in treating ADHD symptoms'". Another user (a vitamin retailer) tweets, "Research today showing that vitamin D, B12 and magnesium may be useful for treating ADHD, find out more here". Still another (a naturopath) writes, "Supplements (quality ones) do help ADHD". Each user either adds, subtracts, substitutes or rearranges certain elements of the story to suit their purposes. Thus in each iteration, the story is reconstructed in accordance with the rhetorical goal of the user. Analysing how messages are changed in such a way can be an interesting way of showing how messages are distorted as they are transmitted. In our own research this will prove helpful as we consider how official information regarding pandemics gets reconstructed as people talk about it on social media.

Rhetoric is thus an important way of analysing social media messages related to pandemics. Both at a micro-linguistic level and at a broader level (frames and representations), rhetorical analysis helps us to understand how social media functions during pandemics to persuade us and construct certain versions of reality.

4.2 Sentiment

Another way of studying intensive influence is to consider sentiment. The reason for categorising this as intensive is that it relates to the emotional content of the message which is likely to have an impact on the reader. Typically though, sentiment is conducted via automated analysis which codes each tweet by matching specific features of the tweet to a certain emotion and then running large-scale analyses to see trends in emotion. Typically this is quite accurate: Researchers have used emotion-related hash-tags to create a large corpus [39] and by using a combination of techniques to generate an emotion score for each tweet they were able to achieve 65% accuracy. Example hashtags were #annoying, #excited and #surprised.

In the case of pandemics and other health issues, sentiment analysis can be useful in identifying clusters of individuals who have negative attitudes towards a particular treatment or intervention since information seems to be shared among users of similar sentiment [34]. This is significant because there is a positive relationship between the expression of sentiment and the retweeting of information [36] which increases the likelihood that affective information about vaccines or illnesses will be shared. Sentiment analysis can also be used to show temporal trends in affective keywords which, as expected, tend to follow key events.

This is, in itself, interesting, but we can go further. One prominent theory sees emotions as being action-oriented [11] and discursive psychologists have pointed out how emotions are rhetorically motivated [10]. This means that emotions generate and are used to generate a particular response. So in the case of Twitter, what are they trying to do in their use of sentiment? What kinds of influence are they seeking? Answering these questions gives us a more nuanced view of what sentiment is accomplishing. Consider these three tweets which relate to Stoptober: (1) "Day one of stoptober... No ciggys for me :-)))", (2) "Having My Last Cig Because In 3 Minutes My #stoptober Starts :(", (3) "RT @E***: #stoptober hahAhahahAHHA what a joke". The first displays happiness, the second, sadness, and the third, amusement. Supposing that large numbers of similar tweets were gathered for each of these three categories – what would that tell us about sentiment relating to Stoptober? Both tweets 1 and 2 indicate that they are engaging in non-smoking but the emoticons are showing opposite emotions, while Tweet 3 displays positive emotion but the user apparently is not taking part in Stoptober. Frankly, this would tell us very little useful information about emotion relating to Stoptober. Different emotions can accompany the same actions and different emotions can also accompany different actions. The best way to understand emotion in tweets like these seems to be through detailed qualitative analysis rather than large-scale corpus analysis. In our own research we are manually coding all tweets based on emotional content to gain a more accurate understanding of how emotion and sentiment relate to pandemic issues.

4.3 Themes and content

Aside from sentiment and rhetoric, a more straightforward way of looking at intensive influence is to consider the topics and content that they talk about. Henrich & Holmes (2011) provide a useful way of thinking about how to analyse any online data [16]: They were interested in developing a set of themes that would let them see public perceptions of the H1N1 vaccine and assumed that the more a topic is mentioned, the more powerful it is in influencing vaccination decision. They looked at 1796 online comments and found the following themes: fear of H1N1 (low and high –

including reasons), responsibility of media, government competency, government trustworthiness, fear of vaccine, pharmaceutical companies and personal protective measures. They then show how these themes vary at different time periods (spring, summer and fall). Similarly, tweets could be analysed for the themes mentioned to see what factors relevant to vaccination are being most discussed at certain points. At such points, if the factors are anti-vaccination themes, authorities should take efforts to counter such messages.

Twitter data need not necessarily be classified in narrow ways such as the themes mentioned above. Broader categories of analysis can also be used. Content analysis comparison of Twitter with traditional news media shows that Twitter and traditional media cover similar topics but distributions differ [42]. Twitter users tweet more about personal life as well as actively retweeting world event topics. They used three categories of analysis: topics, topic categories (arts, world, business, sports, style, tech-sci, health, education and travel) and topic type (event, entity and long-standing). This enabled them to make broad comparisons between the sources. Broad categories could also be used in analysing tweets related to pandemics and this potentially could link to the previous discussion of framing.

This short discussion of intensive influence shows that it can be generated in a variety of different ways. This allows the analyst to look at a range of features in the tweets including emotion, rhetoric and themes. The outcomes of such analysis would be rich and detailed.

5. Conclusion

Influence can be operationalized in two ways: extensively and intensively. While the former is primarily quantitative and the latter qualitative, the two need not be entirely distinct. The two aspects often converge to produce social representations and social norms which are dependent on both aspects being high in influence. It does seem though, that there are limits to what quantitative data can tell us – especially if we are interested in what influences behaviour in a pandemic. More detailed qualitative analysis has the ability to consider how messages are persuasive and how they motivate action. The examples given in this paper show that such analysis would enhance our understanding of health-related behaviours such as vaccination during a pandemic.

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